APPENDIX 6-10

WATER BALANCE MODEL DATA ASSESSENT

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BLACK & VEATCH

TECHNICAL MEMORANDUM

South Florida Water Management District
EAA Reservoir A-1
Work Order No. 4

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Task 2.2 Data Assessment – Water Balance Model

To: Distribution

From: Rafael E. Frias, Kris Hahn, and Jeff Henson

1. OBJECTIVE

The overall objectives of the Water Balance Model are as follows:

- To determine the quantity, duration, and timing of releases to the North New River Canal for irrigation needs;
- To determine the quantity, duration, and timing of releases to the STA 3/4 Supply Canal for Everglades restoration needs;
- To evaluate proposed pumping station location(s) and capacity(ies); and
- To evaluate proposed gate location(s) and capacity(ies).

This technical memorandum summarizes the data required to develop the Water Balance Model, provides an assessment of the data received to date from the District, and states the additional data needed along with the necessary assumptions in order to complete the Water Balance Model.

2. DATA REQUIREMENTS

The data required to perform the Water Balance Model for the EAA-A1 reservoir include:

2.1 Precipitation

Daily precipitation data will serve as an inflow source into the reservoir.

2.2 Evaporation

Daily evaporation data will serve as an outflow source from the reservoir.

2.3 North New River Flows

- The North New River runs parallel to the east side of the EAA-A1 reservoir boundary. Daily average flows to potentially serve as inflow sources are needed at the following locations:
  - Southeast corner of the reservoir footprint, near structure G-370. This existing pump station may be modified from its current configuration of pumping into the STA 3/4 Supply Canal to a modified configuration of pumping into the EAA-A1 reservoir. Therefore, this is a potential location for a pump station.
  - Northeast corner of the reservoir footprint. This is a potential location for a pump station.

2.4 Holey Land Distribution Canal Flows

The Holey Land Distribution Canal borders the reservoir along the south half of the west side of the property line. Flows in the canal are needed at approximately the middle of the west boundary; more precisely at the point where the Holey Land Distribution Canal turns from flowing due east to flowing due south to connect with the STA 3/4 Supply Canal. This is also a potential location for a pump station to serve as an inflow source into the reservoir.

2.5 Reservoir Seepage

Daily reservoir seepage data will serve as an outflow source from the reservoir.

2.6 Demands

Daily irrigation and environmental demands to be met by the reservoir will serve as an outflow source.

2.7 Channel Geometry

In order to get an initial estimate of the potential pump station pumping rates to use in the Water Balance Model, the following channel geometries are necessary to determine the pump station capacities. This would be the maximum possible pumping rate for the existing conditions:

- The North New River from Lake Okeechobee south to structure S-7.
- All of the STA 3/4 Supply Canal.
- All of the Holey Land Distribution Canal.

3. DISTRICT MODELS & OTHER DATA SOURCES

Black & Veatch has obtained information from various sources for use as input into the Water Balance Model. These sources include the District, Office of Modeling (OoM), Interagency Modeling Center (IMC), DHI, Inc. (DHI) and Burns & McDonnell. The OoM and IMC have provided Black & Veatch three different model simulations to assist with the Water Balance Model of the EAA-A1 reservoir, as well as various reports and other data. The first two model simulations were conducted initially based on conceptual reservoir plans. The third simulation

was conducted to determine flows at specific structures along the canal routes. Data that has been obtained from each of these sources is discussed below.

3.1 OoM

The OoM model is set up to serve as a multi-purpose tool for evaluating the water resources of the EAA-A1 reservoir site. The footprint of the simulated reservoir is 16,000 acres with a total usable storage of 192,000 acre-feet. The model assumes a maximum pumping capacity of 2,300 cfs to capture flows in the North New River. The objectives of the reservoir are to meet irrigation demands in the EAA basins, provide environmental deliveries to the Water Conservation Areas, and provide flood protection in the EAA.

This model run covers essentially the same area as reservoir EAA-A1, however, the reservoir is divided into two unequal compartments. Compartment 1 has a storage capacity of 132,000 acre-feet and its inflow is runoff from the North New River basin. Compartment 2 has a storage capacity of 60,000 acre-feet and its inflow is from Lake Okeechobee releases via the North New River. The model does not account for runoff from the Miami Canal Basin and Lake Okeechobee inflow through the Miami Canal. Also the model does not account for improvements to the North New River.

Model outflows include both irrigation and environmental requirements. The flows needed to meet irrigation demands are separated by canal basins. The basins included in the model are the North New River/Hillsboro, West Palm Beach Canal, and Miami Canal basins. The environmental discharges are routed through STA 3/4 into WCA-3A and flow transfer to STA-2. There are also allowances for spillover from one compartment into the other.

3.2 IMC

The IMC model was set up to evaluate the water resources of the entire EAA reservoir system. The footprint of the simulated reservoir was 60,000 acres with a total usable storage of 360,000 acre-feet. The model assumes a maximum inflow pumping capacity of 2,300 cfs from the North New River and 2,700 cfs from the Miami Canal.

The reservoir is divided into two equal compartments. Compartment 1 accepts runoff from the Miami Canal and North New River basins and provides water mainly for agricultural needs. Compartment 2 accepts Lake Okeechobee excess inflow via both the Miami Canal and North New River and provides water mainly for environmental needs. This model simulation also does not account for improvements to the North New River.

The model provides output for both irrigation and environmental requirements. Irrigation needs are divided into the Miami Canal and North New River/Hillsboro basins. The environmental discharges are routed through STA 3/4 into WCA-3A. The model simulation has a daily time step from 1965 to 2000. There are also allowances for spillover from one compartment into another through surge tanks.

A second set of information was received on December 22, 2004, and was the result of discussions with IMC personnel. The time period of the model run was from 1965 to 2000. The flow values from this simulation are structure specific and include inflow from structure S-354 and outflow from S-3, which are located on the Miami Canal at Lake Okeechobee and excess

diversion flow from structure S-8 on the Miami Canal. On the North New River Canal, flow values include inflow from structure S-351 and outflow from S-2, which are located at Lake Okeechobee, and excess diversion flow from structures G-370 and S-7. Structure G-370 is located near the southeast corner of the proposed reservoir and pumps from the North New River into the STA 3/4 Supply Canal. Structure S-7 is located in the North New River alignment at the intersection of canals L-5 and L-6. This simulation also includes daily evaporation and precipitation data for the years of 1965 to 2000 for the cells encompassing the EAA-A1 reservoir site.

Demands from this simulation are divided among several canal basins, including Miami, North New River/Hillsboro, and West Palm Beach. The source to meet these demands is identified as excess Lake Okeechobee outflows.

3.3 DHI

On December 22, 2004, DHI informed Black & Veatch of the subregional modeling services they have provided under CERP. DHI has developed a MIKE SHE/MIKE 11 hydrologic and hydraulic model of the South Florida region. The model is in the final stages of calibration.

3.4 Burns & McDonnell

Black & Veatch has begun discussions with Burns & McDonnell to determine the treatment capacity of STA 3/4. Information on STA 3/4 will be used in the evaluation of the quantity, duration, and timing of releases from the reservoir to the facility to meet the Everglades restoration needs.

4. DATA ASSESSMENT

4.1 Precipitation

The model received from IMC on December 22, 2004 contains mean daily precipitation data for each of ten "2x2 cells" in the model that represents the reservoir for the period of record from 1965 through 2000. Therefore, the average value of all ten cells for each respective day is used as input into the Water Balance Model.

4.2 Evaporation

The model received from IMC on December 22, 2004 contains mean daily evapotranspiration (ET) data for each of ten "2x2 cells" in the model that represents the reservoir for the period of record from 1965 through 2000. A comparison of the ET data provided to historical evaporation data in the vicinity was performed. The data available from DBHydro is pan evaporation. A commonly accepted conversion of pan evaporation to actual evaporation is 70 percent of the pan evaporation equals actual evaporation. A comparison of the ET data provided to actual evaporation data, using this conversion, revealed little difference between the two values. Therefore, the average value of the ET data from all ten cells was used as input into the Water Balance Model.

4.3 North New River Flows

The model received from IMC on December 22, 2004 contains flow data from structures S-2, S-351, S-7 and S-370 on the North New River. Structures S-351 and S-3 are located at Lake Okeechobee upstream of the EAA-A1 reservoir, S-370 is located at the intersection of the STA 3/4 Supply Canal, and S-7 is located south of the EAA-A1 reservoir at the intersection with Levee L-5. Currently, we are using the entire combined flows from G-370 and S-7 as inflow from the North New River into the Water Balance Model of the EAA-A1 reservoir.

Additional required information includes potential regulatory releases from structure G-370 and S-7 prior to inflow into the reservoir. This data was requested in a memo to the District dated January 10, 2005.

In the meantime, we are assuming that the entire volume of flow over structures G-370 and S-7 will be used as inflow into the EAA-A1 reservoir.

4.4 Holey Land Distribution Canal Flows

The model received from IMC on December 22, 2004 contains flow data from structures S-354, S-3, and S-8 on the Miami Canal. Structures S-354 and S-3 are located at Lake Okeechobee upstream of the EAA-A1 reservoir, and S-8 is located south of the reservoir at the intersection with Levee L-5. Review of the data indicates that the simulation does not provide excess diversion flow from structure G-372, which discharges from the Miami Canal into the Holey Land Distribution Canal and eventually into STA 3/4. The data from this structure will be necessary to account for the flow along the Holey Land Distribution Canal into the EAA-A1 reservoir. Currently, we are using only the data from Structure S-8 as inflow into the Water Balance Model.

Additional required information includes irrigation demands from the Holey Land Distribution Canal from the intersection of the Miami Canal to the proposed inflow pump at the EAA-A1 reservoir. This data request was submitted in a memo to the District on January 10, 2005. Until the flow data from structure G-372 and irrigation demands are provided, we will continue to use only the flow from Structure S-8 as inflow into the model.

4.5 Reservoir Seepage

Preliminary reservoir seepage data was obtained from the Levee Optimization Report (JM/JV, 2004). This data is currently used as input into the Water Balance Model. Monitoring results from the test cell program will not be complete until after the initial Water Balance Model is submitted. The Water Balance Model will be updated with the seepage results from the test cells as part of Work Order 5. The refinement of other necessary assumptions will also be made as more accurate data becomes available.

4.6 Demands

Demands information for the EAA is provided in the IMC model received on December 22, 2004. The information includes Total Supplemental Demand in the EAA and Total Supplemental Demand to be met by Lake Okeechobee. The Lake Okeechobee demand is

divided into the demands to be met at the Miami Canal, North New River/Hillsboro, and West Palm Beach Canal basins.

The demands information provided does not specify between irrigation and environmental demands and the specific demand that should be met by the reservoir. Further clarification was requested in a memo to the District dated January 10, 2005.

Currently we are using the demands to be met at the North New River/Hillsboro basin as the irrigation demands. Environmental demands are still required.

4.7 Channel Geometry

The North New River Canal geometry was taken from the HEC-RAS modeling work in the EAA provided by the District in the CD *"Bolles&CrossCanals_-PreliminaryHydraulicsReport."* The HEC-RAS model, *"existing.prj,"* was adapted to isolate the section of the North New River that bounds the reservoir along the east side of the property line in order to develop a rating curve and determine the capacity of the river along that segment. See Figure 1, pg 10, for levee heights, channel flowline elevations, and locations of significant structures.

The model developed uses the same downstream boundary condition of normal depth, with a slope value of 0.0001 ft/ft, as the *"existing.prj"* model. The accuracy of this assumption is currently being investigated and will be determined once the details of structure S-7, and potentially G-371, are completely understood. The flat slope (i.e. lack of relief) of the North New River results in a subcritical flow regime, therefore an upstream boundary condition for this reach is not required.

The cross-sectional information necessary to develop rating curves and determine the capacity of the STA 3/4 Supply Canal and Holey Land Distribution Canal was extracted from the following sources provided by the District:

- Wantman Group, Inc., May 2004, South Florida Water Management District Everglades Agricultural Area Storage Reservoirs "Georgia Parcel" - *Specific Purpose Survey.*
- F.R.S. & Associates, Inc., February 2004, South Florida Water Management District Everglades Construction Project - Palm Beach and Broward Counties, Florida – *Stormwater Treatment Area 3/4 Works As-Built Survey.*

Additional required information includes cross-sectional data for the stretch of the Holey Land Distribution Canal that runs east from the Miami Canal to the EAA-A1 reservoir site. This data request was submitted to the District on January 10, 2005.

In the meantime, it will be assumed that the Holey Land Distribution Canal has the capacity to handle all of the flow available from the G-372 pump station.

See Figure 2, page 11, for a schematic of our understanding of the existing system.

5. SUMMARY

This memorandum is a summary of the data compiled in developing the initial Water Balance Model. Included is a discussion of existing data received from the District, additional data

required to complete the model, and the assumptions necessary to complete the Water Balance Model. Additional data will come from Work Order 5, which has not been completed. Therefore, the initial Water Balance Model will need to be updated with this additional data as part of the scheduled Work Order 5.

Data requirements to be used as inflows and outflows in the Water Balance Model include: precipitation, evaporation, North New River flows, Miami Canal flows, Holey Land Distribution Canal flows, reservoir seepage, and irrigation and environmental demands. Complete precipitation and evaporation data and partial flow data has been obtained from the second IMC submittal on December 22, 2004. Demands are also provided in the second IMC submittal, but questions remain as to the applicability of the data. Additional data received includes information from OoM, Levee Optimization Report, HEC-RAS modeling, and survey in the EAA. DHI and Burns & McDonnell were contacted to get their input on the previous work performed in the EAA region.

6. REFERENCES

JM/JV – Jacobs/Montgomery Joint Venture, May 20, 2004, "Report for Conceptual Levee High Alternatives," Central and Southern Florida Project, Comprehensive Everglades Restoration Plan, Everglades Agricultural Area Storage A-1 Reservoir Levee Optimization.

Kimley-Horn and Associates, Inc., June 2004, Everglades Agricultural Area Storage Reservoirs – Phase 1, "H Existing Conditions, H.6 Water Management."

Figure 1 NNR HEC-RAS Data

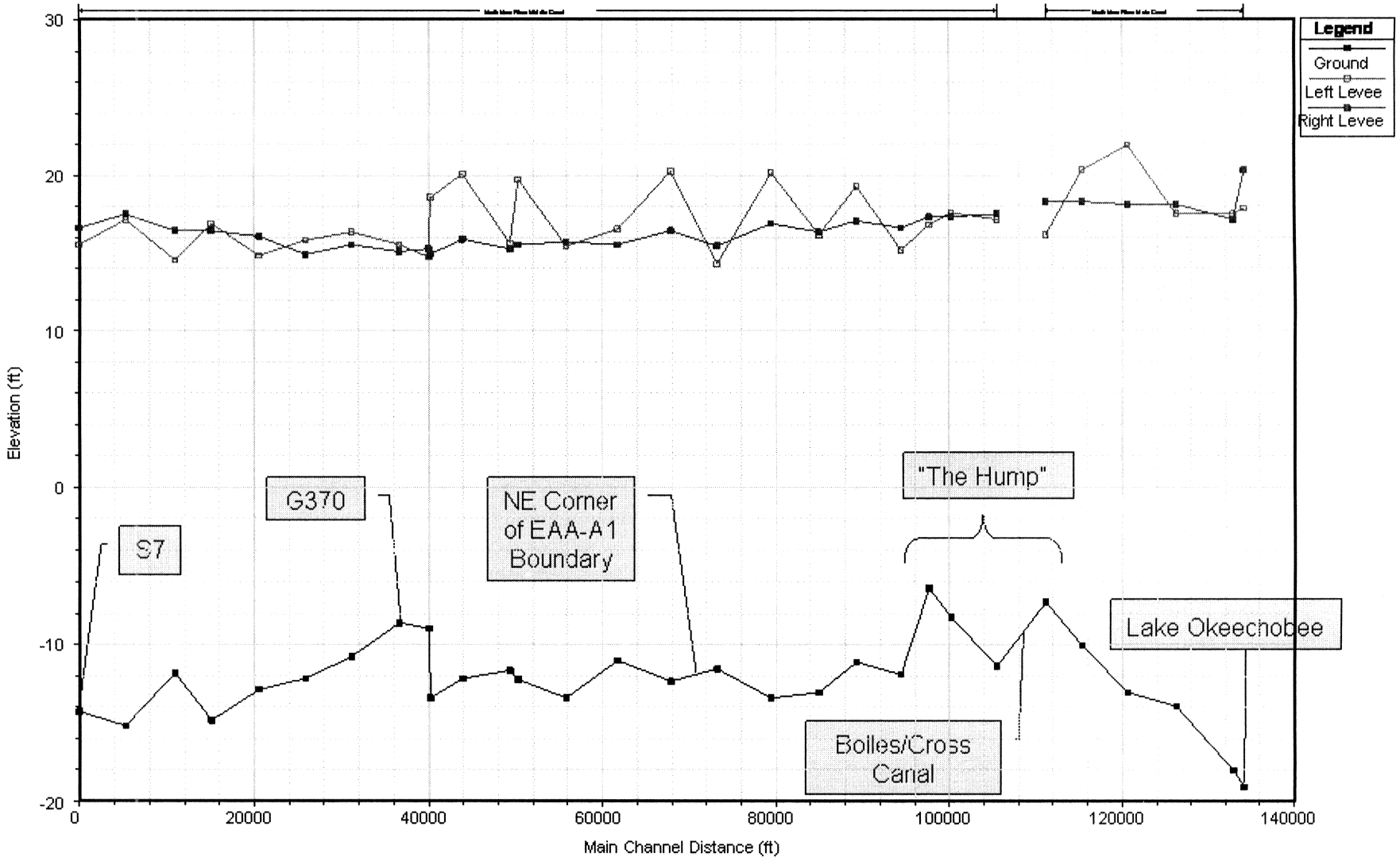
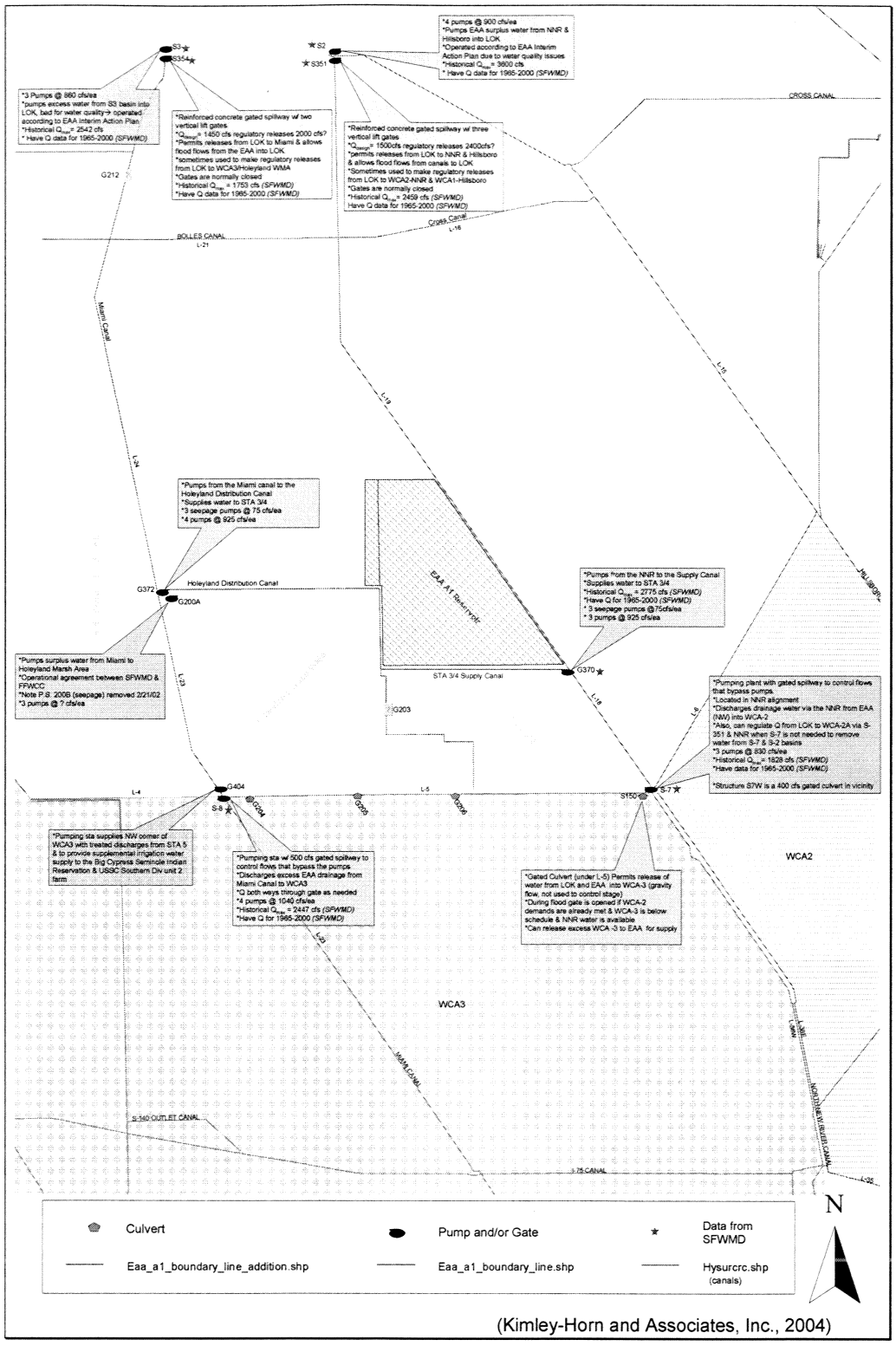


Figure 2 Schematic of EAA Reservoir A-1 Area



(Kimley-Horn and Associates, Inc., 2004)